ECONOMIC ORNITHOLOGICAL COMMITTEE.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

INTERIM REPORT

ON THE

FEEDING HABITS OF THE ROOK

(*Corvus frugilegus*, Linn.).

BY

H. S. LEIGH, M.Sc.,

The University, Manchester.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
By DARLING AND SON, LTD., BACON STREET, E.

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ECONOMIC ORNITHOLOGICAL COMMITTEE.

A. E. Shipley, D.Sc., F.R.S.,
Chairman.

H. S. Leigh,
Secretary.

In the autumn of 1908 a Committee of the British Association for the Advancement of Science was formed, through the initiative of Dr. C. Gordon Hewitt, to investigate the feeding habits of certain birds the economic position of which affects agricultural science.

It was decided that attention should at first be concentrated on three species, viz., rook, starling, and chaffinch. For some considerable time there has been much doubt and discussion regarding the economic status of these three birds, and it was felt that a properly organised inquiry should be conducted with a view to deciding whether all or any of the three species under consideration are beneficial or injurious to agricultural and horticultural interests in the British Isles.

Although the feeding habits of all three species (rook, starling, and chaffinch) have been investigated, the present account concerns the rook only; the other reports are in course of preparation and will, it is hoped, soon be ready for publication.

This report is of an interim nature only, as it is impossible to base a reliable account of the economic status of the bird upon the small number of specimens which have been received up to the present time. It was thought, however, by the Committee that a report on the investigation up to its present stage of completeness should now be published, showing (i) the nature of the work that has already been done concerning the problem, and (ii) where further help is needed before a more complete statement can be made.

The work has been carried on at the University of Manchester in co-operation with the Board of Agriculture and Fisheries. The Board recognised the importance of such an inquiry, and, in addition to giving some financial assistance, have been instrumental in obtaining for the Committee a grant of money from the Development Fund. Without this help from the Board the work would have been seriously handicapped if it had not been impossible.

The following have contributed in the identification of the gizzard* contents:—

Dr. C. Gordon Hewitt, Messrs. J. Mangan, J. T. Wadsworth, T. G. B. Osborn, J. Ray Hardy, J. Standen, H. Murray, and H. S. Leigh.

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* The alimentary canal of the rook has no definite crop, and the food which has been examined was obtained from the gizzard, and in one or two instances from the gullet.

Specimens received.—The total number of rooks received was 218; of these the gizzards of nine were empty, leaving 209 as the number which were examined.

It was requested by the Committee that each correspondent should, as far as possible, send in five specimens each month, together with a "form of particulars."* Although the number of birds received fell much below that which the Committee had hoped to obtain, they would like to take this opportunity of gratefully acknowledging the valuable assistance rendered to the investigation by those correspondents who have returned specimens. The following is a list of the correspondents who have assisted:—

Acton, T. A., Arnold, A., Barkley, M. D., Baxter, Miss E. V., Burrows, C. L., Buxton, P. A., Cox, L. C., Dee, J., Edwards, E. L., Edwards, Col. W., Gamble, C., Garner, Miss E. M., Gavin, A. G., Harris, G., Herbert, Rev., Horn, P., Lloyd, Col. R. O., Millington, E. N., Nicholson, W. A., Patten, Prof., Pope, J. M., Shillitoe, F., Wroth, T. S., Thomber, B., Tottenham, C. W. L., Wilde, F., Willett, W.

The area covered by this investigation is fairly wide and varied in character; birds have been received from 39 localities, but for convenience these have been arranged according to the counties in which they occur.

The subjoined table (No. I.) shows the counties represented and also the number of specimens received from each during every month. It will be noted that the supply of birds from the counties enumerated is insufficient, in regard to total numbers and regularity to base a correct estimate of the rook's economic position thereon. For example in the county of Denbigh (which includes four localities, two near Wrexham and two near Llangollen) a good number have been received during the months, January to June inclusive, and also August, but very few have been received during September and December, and none for July and November. The above principle applies of course to the other counties and is in many cases much more pronounced. In some instances only one, two, or three birds have been received from one county during the whole year. Further, very many fruit-growing and agricultural localities are not represented at all. It is hoped, however, that by the publication of this report the deficiencies will be readily seen and an attempt made to supply, in the future, material from the districts and at the times of year when it is most needed.

Table No. I. shows the number of birds obtained from each county during each month, together with the totals. The birds with empty gizzards (nine) have not been included. A total of 15 appears for February compared with 16 in Table II., the reason for the discrepancy being that one specimen arrived without any particulars as to locality.

It has not been possible to publish a complete and detailed tabulation of the gizzard contents in the present account. This

* This form is filled in by the correspondent and contains all the particulars of the conditions under which the bird was shot.

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would render the work rather large and it is hardly necessary at the present time. A complete tabulated statement* of the food of the rook has been made and the notes will be incorported in a larger and fuller account which it is hoped will be published in the near future. In this table the various insects are classified as either beneficial, injurious, or neutral, and the same divisions are allowed for the other invertebrates; grain, roots, and miscellaneous food are also classified.

Nature of Food.

It has been stated on many occasions that the rook feeds largely upon insects in all stages. This appears to be true for certain periods of the year, but the rook is not very particular as to its diet, and if the supply of insects falls short (as it does during the winter months) a good deal of grain and other food is taken. The rook would, in fact, appear to be omnivorous.

It is perfectly obvious that the nature of the rook's food must not be judged from particulars obtained at any special period of the year and from certain localities, but should be based on information obtained from the examination of a large number of specimens which have been killed over a large area; moreover the supply of birds should be as even as possible each month and continued for a few years. If this plan could be carried out birds would be obtained which had been living under many different conditions.

The problem is one of great complexity and, if reliable results are to be obtained, many factors must be taken into consideration. Not only does the food of the rook vary at different times of the year and according to the available supply, but it also varies in different phases of the bird's life history. It is well known that during the breeding season birds take a much larger proportion of insects as food than at other times, so that it is important not only to examine as many birds as possible at this time of year, but the number should contain many nestlings. Very few nestlings have been received, but in the case of nine received in May from Wasperton Hill Farm, Warwickshire, and Treffgarne, Pembrokeshire, it was found that the principal food consisted of injurious insects.

Unfortunately, very few birds have been received from these localities during the other months of the year,† so that it is impossible to say whether much damage is done by the rook during these months in the particular districts, and, if so, whether the injurious effect more than counterbalances the benefit conferred during the breeding season.

It will be seen, by reference to Table No. II., that a very large proportion of the food taken by the 209 specimens during the months, September to May inclusive, was grain, and it might be said that as more grain than animal food was found in the gizzards

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* Copies of the detailed tabulation of the food may be seen either at the offices of the Board of Agriculture and Fisheries or at the University of Manchester.

† *See* Table No. I.

of most of the birds from the other localities during the autumn, winter, and spring months, the same thing would be likely to apply to the localities in Warwickshire and Pembrokeshire, and that it could therefore be said, with more or less accuracy, whether the birds were on the whole doing more harm than good or vice versa to the farmer during the whole year. The environmental conditions, however, might, and probably would, vary in different counties, and it would therefore be unsafe to adopt the above method. It appears that the only satisfactory way of obtaining an estimate of the rook's economic position is, firstly, by having an even supply of birds each month from the same and as many localities as possible; when this has been done the results obtained can be compared, and after taking into consideration certain other questions such as the available food supplies in each district, and migration, it would, no doubt, be possible to arrive at a fairly reliable conclusion of the general effect which the rook may have on agricultural interests in the counties investigated.

The following is a monthly register in which I have given a complete statement of the food in the stomach each month:—

January.—The number of birds received was 41; of these, the gizzards of 21 were full, five were three-quarters full, 11 about half full, one almost empty, and three empty. The contents of the gizzards were as follows:—

Two dor beetles (*Geotrupes stercorarius*, Fabr.), and fragments of one dor beetle (*Geotrupes* sp.), fragments of one ground beetle (*Carabus* sp.), five "wireworms" (four *Athous hæmorrhoidalis*, Fabr., and one *Agriotes* sp.); two larvæ of rove beetles (*Xantholinus* sp.).

One larva of crane-fly (*Tipula* sp.) one larva of a fungus-gnat (*Mycetophilidæ*), one larva of Muscid type, one small Dipterious pupa.

One slug, probably *Agriolimax agrestis*, Linn., also remains of shell of a "top shell" (*Trochus* sp.). Twenty-four egg capsules of earthworm (*Lumbricus* sp.), bits of meat (apparently beef), bread and bones, portions of egg-shell, some unrecognisable animal matter. Much wheat (some sprouting), oats, black oats, much barley; maize; fragments of many acorns (*Quercus robur*, Linn.); fragments of seven seeds of ash (*Fraxinus excelsior*, Linn.); one seed of charlock (*Brassica sinapis*, Linn.), two unrecognisable seeds, many fragments of mangold, a quantity of potato fragments, roots of sow thistle (*Sonchus arvensis*, Linn.), many fragments of a root which appeared to be turnip, some fragments of unrecognisable root and miscellaneous vegetable matter; some grit and earth.

February.—The number of birds received was 17, and generally speaking, the gizzards of 11 were full, five were three-quarters full, and one was empty. The contents as follows:—

Two larvæ of ground beetles (*Amara* sp.), remains of one earwig (*Forficula* sp.), portion of one earthworm (*Lumbricus* sp.), including many setæ, bits of meat and fat.

Much grain, including wheat, oats, barley, many fragments of acorns (*Quercus robur*, Linn.), turnip fragments, bits of bean, portion of decaying potato, some blades of grass; some earth and grit.

March.—The number of birds received was 41; of these, 18 were full, 8 were three-quarters full, 13 rather less than half full, and two were empty. The contents as follows:—

Twenty-six dung beetles (one *Aphodius fimetarius*, Linn., and one *Aphodius contaminatus*, Herbst.); nine complete larvæ and remains of two larvæ of ground beetle (*Carabus* sp.); 109 larvæ of click beetles (*Elateridæ*), including remains of about 24 wireworms (*Agriotes* sp.); remains of 13 click beetles (*Agriotes obscurus*, Linn.); fragments of two beetles (sp. ?).

Five complete larvæ and head of one larva of a crane-fly (*Tipula*, sp.), eight larvæ of *Nemocera* sp. ?, two larvæ of *Bibio* sp., four larvæ of the Muscid type, two pupa cases of a Muscid (one large and one small), and a portion of one Muscid pupa. One queen wasp (*Vespa germanica*, Linn.), leg of a spider (sp. ?), remains of five earthworms (*Lumbricus* sp.), and other fragments, including setæ, five earthworm cocoons, some pieces of carrion.

Much grain, including wheat, oats, barley, maize, some fragments of acorn (*Quercus robur*, Linn.), one seed, probably *Ruppia* sp., bits of turnip (*Brassica campestris*, Linn.), potato fragments, four pieces of underground stem of sow thistle (*Sonchus arvensis*), two small portions of an unrecognisable root, bits of grass and much miscellaneous vegetable matter, some grit and earth.

April.—The number of birds received was 17; of these, five were full, two almost full, four about half full, three about quarter full, two almost empty, and one empty.

Lepidoptera.—One larva (*Noctuidæ*), two Noctuid larvæ, one probably *Agrotis* sp., and one "large yellow underwing" (*Triphæna pronuba*, Linn.).

Coleoptera.—Twenty-one dung beetles (twenty *Aphodius prodromus*, Brahm and one *Aphodius* sp.), and remains of one dung beetle (*Aphodius fimetarius*, Linn.), five click beetles (one *Cryptorhynus riparius*, Fabr., and four *Agriotes obscurus*, Linn.), one larva of a ground beetle (probably *Carabus* sp.), fragments of three ground beetles (*Carabidæ*), two larvæ of rove beetles (*Philonthus* sp.) and portions of one rove beetle (*Staphylinidæ*), remains of nine weevils (eight *Barynotus obscurus*, Fabr. and one *Sitones* sp), undeterminable remains of about ten beetles, which include some weevils.

Diptera.—One larva of fungus-gnat (*Mycetophilidæ*), three larvæ of the Muscid type, 23 larvæ of a crane-fly (*Tipula* sp.), one larva and two pupæ (*Anthomyia* sp.); one pupa and portions of nine pupæ of Muscid type (probably *Anthomyia* sp.), one small unidentifiable pupa case; one centipede (*Geophilus* sp.); one earthworm (*Lumbricus* sp.); four earthworm cocoons and remains of about forty; many setæ of earthworms, some of which belong to the *Oligochæta*.

Oats, barley, fragments of acorns (*Quercus robur*), one seed, probably Achene (*Ranunculaceæ*), bits of potato, three seedlings (sp. ?), one piece of moss (*Jungermannia* sp.), fragments of grass, and miscellaneous vegetable matter.

May.—The number of birds received was 33, of these, the gizzards of 10 were full, three nearly full, 10 rather less than

half full, seven about quarter full, two nearly empty, and one empty. The contents were as follows:—

Lepidoptera.—One larva of "Light Arches" (*Xylophasia lithoxylia*, Fabr.), one larva of a "Wainscot" (*Nonagria* sp.), eleven larvæ belonging to the *Bombycidæ*, four Noctuid larvæ, consisting of two small specimens and portions of two others, one of which was large; one unrecognisable larva.

Coleoptera.—Remains of seven dung beetles (two *Aphodius fimetarius*, Linn., and five *Aphodius* sp.), fragments of two dor beetles (*Geotrupes* sp.), ten wireworms (*Agriotes* sp.), five larvæ of ground beetle (*Carabus* sp.), fragments of four ground beetles (two *Carabus* sp., one *Pterostichus madidus*, Fabr., and one *Pterostichus* sp.), four larvæ of rove beetles (*Staphylinidæ*), and remains of two rove beetles (*Staphylinidæ*), 14 weevils (four complete *Otiorhynchus picipes*, Fabr., and remains of ten *Otiorhynchus* sp.); one complete larva (unidentifiable) and a large number of small unrecognisable fragments representing several species.

Diptera.—One hundred and twelve larvæ of crane-fly (24 *Tipula oleracea*, Linn. and 88 *Tipula* sp.); remains of 39 *Tipulid* larvæ, consisting in some cases of heads only; two larvæ (*Leptis* sp.), three larvæ (Muscid type), and one larva which resembles *Ptychoptera*; one pupa (Muscid type), two empty pupa cases, and remains of two or three; one spider.

Myriapoda.—Two *Geophilus* sp., one *Lithobius* sp., and a few segments of a *Julus* sp.; fragment of one *Chilopod*.

Mollusca.—Three hairy snails (*Hygromia hispida*, Linn.); portion of one slug (sp. ?).

Vermes.—Three Nematode worms; 60 earthworms (*Lumbricus* sp.) of varying sizes, and fragments of two; a quantity of setæ and two cocoons; fragments of one tape-worm; small piece of half-digested carrion.

Oats (some sprouting), barley (some sprouting), pieces of acorns, turnip fragments, and a large quantity of potato fragments; remains of five beans and nine tubers of earth nut (*Conopodium denudatum*); several pieces of moss (*Tungermannia* sp. and *Polytrichum* sp.), a few leaves of clover (*Trifolium* sp.), many fragments of grass and grass shoots; also a quantity of indistinguishable vegetable matter.

June.—The number of birds received was 16, and, generally speaking, the crops of six were full, five were about half full, four nearly empty, and one empty. The contents were as follows:—

Lepidotera.—One Noctuid larva; one adult larva of wood-leopard moth (*Zeuzera æsculi*, Linn.); remains of one or more large moths (unidentifiable).

Coleoptera.—Six dor beetles (*Geotrupes* sp.); remains of three dung beetles (two *Aphodius fimetarius*, Linn., and one *Aphodius* sp.); remains of four ground beetles (one *Amara trivialis*, Gylh; one *Harpalus griseus*, Panz, two *Pterostichus* sp.); remains of seven wireworms (*Elateridæ*); two complete weevils (one *Otiorhynchus ovatus*, Linn, and one *Barynotus obscurus*, Fabr.); remains of three weevils (one *Barynotus mœrens* and one *Barynotus* sp., one *Sitones* sp.; remains of three rove beetles

(*Staphilinidæ*, one being *Quedius* sp.); remains of one or two Phytophaga (probably *Chrysomela varians*, Fabr., and *Prasocuris juna*); large number of unrecognisable fragments representing many individuals.

Diptera.—About 700 eggs of crane-fly, *Tipulidæ* (about 300 being probably those of spotted crane-fly (*Pachyrhina maculosa*); 72 larvæ of crane-fly (*Tipula* sp.), 61 adult crane-flies (60 *Pachyrhina maculosa* and one *Tipula* sp.); one fly (*Anthomyidæ*).

Many setæ of earthworm (*Lumbricus* sp.), remains of one shrew (*Sorex* sp.), skull bones and hair and fragments of egg-shell; grit.

Oats, barley, wheat and a few fragments of maize. Portion of small unripe fruit (probably *Rosaceæ*); a large quantity of fragments of potato; many pieces of unidentifiable roots, but some appeared to be wild carrot; some grass, and much undeterminable vegetable matter.

July.—The number of birds received was 7; and of these the gizzards of three were almost full, three about one-third full, and one almost empty. The contents were as follows:—

Lepidoptera.—Remains of one larva (unidentifiable).

Coleoptera.—Remains of one dung beetle (*Aphodius contaminatus*); remains of five larvæ (*Scarabæidæ*); remains of one dor beetle (*Geotrupes* sp.); remains of fifteen ground beetles (two *Carabus* sp., three *Pterostichus madidus*, Fabr., eight *Amara apricaria*, Payk., one *Harpalus æneus*, Fabr., one *Harpalus* sp.); two carrion beetles (one *Sphæridium scaraboides* and one *S. bipustulatum*); remains of eleven weevils (four *Barynotus obscurus*, three *Barynotus* sp., one *Alophus triguttatus*, one *Hypera* sp., two *Sitones* sp.); remains of several rove beetles (*Staphylinidæ*), including one *Philonthus varius*, Gyll.; *many* fragments representing a large number of beetles, the majority unidentifiable, but a few were those of several ground beetles (*Geodephaga*).

Diptera.—Several hundreds of ova and two larvæ of a crane-fly (*Tipulidæ*); four wings of a Muscid. One hymenopterous insect, probably an Ichneumon. Fragments of three striped snails (*Helicella virgata*, Da Costa) and some broken Mollusc shells; many setæ of earthworm (*Lumbricus* sp.); small piece of bone; grit.

Black oats, large amount of potato fragments; many bits of grass and several grass seeds; some unrecognisable vegetable matter.

August.—The number of birds received was 13; of these, the gizzards of nine were full; one was half full, two about quarter full, and one nearly empty. The contents as follows:—

A few *Lepidopterous* scales.

Coleoptera.—Remains of four dor beetles (two *Geotrupes vernalis* ? and two *Geotrupes* sp.); remains of five dung beetles (one *Aphodius fossor*, Linn., three *Aphodius fimetarius*, Linn., one *Aphodius* sp.); one larva of a dung beetle (*Scarabæidæ*); remains of fifteen ground beetles (one *Pterostichus vulgaris*, three *P. madidus*, eight *Pterostichus* sp., three *Carabus* sp.); two wireworms (*Elateridæ*); one larva of a rove beetle (*Staphylinidæ* ?); remains of seventeen weevils (two *Barynotus elevatus*,

fourteen *Sitones griseus*, Fabr., one *Sitones* sp.); remains of twelve "flea" beetles (*Crepidodera ferruginea*, Scop.); one large unidentifiable larva; fragmentary remains of a large number of beetles, but include *Pterostichus*, *Geotrupes*, *Aphodius*, and some weevils.

Diptera.—Twenty-one (*Anthomyid* ?) larvæ, seven larvæ of the Muscid type, two flesh flies (*Sarcophaga carnaris*, Linn.), and two large (blow) flies, being different species, but probably *Calliphora*; remains of three large crane-flies (*Tipula* sp.).

One ant (*Myrmica* sp.), fragments of one Hymenopterous insect, one grasshopper, two "harvestmen" (*Phalangidæ*), remains of one earwig (*Forficula* sp.). Three striped snails (*Helicella virgata*, Da Costa) and one wrinkled snail (*Helicella caperata*, Montagu). Many portions of earthworm (*Lumbricus* sp.), including setæ, bones of a young frog (*Rana* sp.), some grit. Oats, black oats, barley, wheat, a quantity of pieces of potato, one root (unidentifiable), remains of about two beans, a large number of blades of grass, and much unrecognisable vegetable matter.

September.—Four birds only were received; the gizzards of all were full. The contents as follows:—

Coleoptera.—One dung beetle (*Aphodius fimetarius*, Linn.); remains of four ground beetles (one *Carabus* sp., three *Pterostichus* sp.); remains of one click beetle (*Elateridæ*); remains of two rove beetles (*Staphylinidæ*); remains of one weevil (*Otiorhynchus* sp.); unidentifiable fragments (including elytra) of a few small species of beetles.

Remains of about fifteen crane-flies, probably *Tipula oleracea*, Linn.; one large Hymenopterous insect (sp. ?).

A good quantity of wheat and barley; some grit.

October.—The number of birds received was eight, of these, the gizzards of three were full, two were half full, and three about quarter full. The contents as follows:—

Coleoptera.—Remains of three dor beetles (*Geotrupes* sp.); remains of one ground beetle (*Pterostichus* sp.); remains of one weevil (*Otiorhynchus* sp.); unidentifiable fragments of several beetles.

Twenty-one larvæ of the Muscid type, one larva of *Eristalis* sp., eight Dipterous larvæ (unidentifiable), one pupa of Muscid type, remains of one crane-fly (*Tipula* sp.); remains of one wasp (*Vespa* sp.); remains of two earwigs (*Forficula* sp.); setæ of earthworm (*Lumbricus* sp.).

Barley, wheat (some germinating), maize, husks of oats, many fragments of acorn, fragments of walnut (*Juglans*), a large quantity of undeterminable vegetable matter. A large amount of grit.

November.—The number of birds received was eight; generally speaking the gizzards of six were full, one about quarter full, and one nearly empty. The contents were as follows:—

Fragments of one dung beetle (*Xylotrupes* sp. ?).

Oats, barley, a quantity of wheat, many fragments of acorn (*Quercus*), fragments of two beans; some unidentifiable vegetable matter, including two small seeds. Some grit.

December.—The number of birds received was thirteen, and generally speaking the gizzards of nine were full, three were half full, and one nearly empty. The contents as follows:—

Lepidoptera.—Three Noctuid larvæ (one *Xylophasia* sp.), two *Apamea* sp.; unrecognisable remains of five Noctuid larvæ.

Coleoptera.—Three larvæ of ground beetles (one *Carabus* sp. and two *Philonthus* sp.); two ground beetles (*Carabus* sp.); one larva and one adult cock-chafer (*Melolontha vulgaris*, Linn.); 157 "wire-worms" (152 *Agriotes* sp., three *Athous hæmorrhoridalis*, Fabr., and two sp. ?); three "click beetles" (*Agriotes lineatus*, Linn.); remains of two "pill beetles" (*Cytilus varius*, Fabr.).

Diptera.—Ninety-five larvæ of crane-fly, probably *Tipula oleracea*, Linn, and remains of three or four of same; two larvæ (*Anthomyia* sp.), five larvæ (*Leptis* sp.), 155 larvæ of Muscid type, and sixteen larvæ (probably *Muscidæ*).

One centipede (*Geophilus* sp.), two Nematode worms, one cocoon of earthworm (*Lumbricus* sp.), and setæ of the same, pieces of meat, number of fragments of egg-shell (fowl's), bread, two tea leaves and one feather (rook's).

Wheat, oats, much barley, maize, many pieces of acorn and potato, portion of one seed of holly (*Ilex*), one seed (similar to *Cotoneaster*), a few pieces of a stem (sp. ?), and one blade of grass.

In the following notes the nature of the food of rooks under different headings has been summarised.

Vegetable Food.

Grain.—The greater part of the food here recorded consisted of grain, which was found in 157 cases. Oats were in greatest abundance and were recorded in 98 instances; barley occurred 55 times, wheat 28 times, and maize was found in 11 cases.

Seeds other than Grain.—Seeds occurred in only 13 cases; in six there were portions of bean; seeds of ash were present once; seed of *Ruppia* sp. once; seed of charlock once; a single instance of a ranunculaceous weed seed; one case of a single holly and *Cotoneaster?* seed in the same gizzard; and there were two cases of seed the identification of which was impossible.

Fruit.—Remains of fruit were found in 33 cases, and this consisted almost entirely of acorns; portions of acorns occurred in 31 instances and walnut once. In one gizzard part of a small unripe fruit (probably Rosacaeus) was present.

Roots.—Roots occurred in 63 gizzards. Potato was in greatest abundance, it having been found in 43 cases; turnip occurred seven times; mangolds twice; sow thistle twice; grass roots twice; a root, which was probably wild carrot, once; and earth nut once. In six gizzards unrecognisable roots were present.

Herbage.—Pieces of grass occurred 29 times, but in some cases there was only a blade or two; clover leaves were found once.

Miscellaneous Vegetable Matter.—Vegetable matter, which could not be identified, occurred in 27 cases.

Animal Food.

Insects.—The greater portion of the animal food consisted of insects, which were recorded in 105 cases.

Coleoptera.—In 80 cases beetles or their larvæ were present; "wireworms" or their adults being found 19 times.

Lepidoptera occurred in 14 cases, larvæ were found in 12 instances and scales and other remains of adults twice.

Diptera occurred 56 times, all stages being represented, but the larval form (leather-jackets) of the crane flies were predominant; they were found in 32 cases.

Hymenoptera were found on six occasions and included two wasps, one ant, and one ichneumon?

Orthoptera occurred four times; earwigs were found four times; and a grasshopper once.

Molluscs.—In nine cases molluscs were found, including two slugs.

Vermes.—Remains of earthworms, including their egg capsules, occurred in 46 instances; remains of an *Oligochæt* once; in three gizzards *Nematode* worms.

Myriapoda.—Centipedes and millipedes occurred five times.

Arachnida.—Spiders occurred twice, and "harvestman" (Phalangid) once.

Other Animal Matter.—In one gizzard the remains of a shrew was found, and in another case the bones of a frog, and in five cases portions of egg-shell (generally fowl's) were found. Unrecognisable animal matter occurred once.

Miscellaneous Food.

In 15 instances meat and carrion occurred, and kitchen refuse was found in nine gizzards, and this included bits of bread three times, potato twice, portions of bone three times, and tea-leaves once.

Unrecognizable miscellaneous food occurred once. Summarising the 209 rooks examined, grain was in greatest abundance, it having been found in 73 per cent. of the gizzards, and in 57 cases in which it occurred it formed 70 to 80 per cent. of the food contents. Roots of value to the farmer (*i.e.*, potatoes, mangolds, &c.) were found in 20 per cent. of the birds. Injurious insects occurred in 36 per cent. of the gizzards, the percentage for "leather-jackets" (*Tipulidæ*) being 15 and 9 for "wireworms" or their imagos (*Elateridæ*). At least two instances in this inquiry show in a very pronounced manner the number of injurious insects which may be taken by a single rook in the course of a short time. Thus in one gizzard 95 whole *Tipulid* larvæ ("leather-jackets") were found, and as many as 103 *Elater* larvæ ("wireworms") were present in another; it is obvious therefore that these birds were rendering valuable service to the farmer.

Table No. II. shows the number of birds received each month and the percentage number of times the different food items are taken. It may here be mentioned that the prcentages of "useful insects" for March and April were comprised almost entirely of *Carabidæ*.

Grain was taken once from pheasant food; in this case its occurrence is included in "Miscellaneous Vegetable Matter" and not "Grain" as the bird was really doing no harm to the landowner.

Only such items are included under "Roots" as are beneficial or of value to the farmer, such as potatoes, mangolds, turnips, &c. When the bird was evidently not doing any damage to crops by feeding upon potatoes, &c.; the occurrence of such is included in the space for "Miscellaneous Vegetable Matter." Such instances happen when the rook was feeding on a piece of land recently under potatoes or on pieces of potato thrown away.

Unrecognisable roots and seeds or portions of the same have been included in the "Miscellaneous Vegetable Matter," as have also certain seeds which are of no very direct economic importance, such as acorns or seeds of ash, &c.

In "Miscellaneous Animal Matter" are included such items as occur in kitchen refuse, *i.e.*, meat, bone, egg-shell, &c., when the bird was evidently feeding on food thrown away.

Grass roots have been included in "Weed, Seeds, and Roots."

It will be observed from Table No. II. that the percentage of animal food taken from April to September is large and also that this is made up mainly of injurious insects; so that for six months rooks appear to take a large quantity of injurious insects as food. On the other hand we have to record a large quantity of grain in the rook's diet; for nine months of the year (from September to May inclusive) the percentage of grain food is very high and in September and October reaches 100 per cent.; it only falls to a low level in June, July, and August.

It would, however, be most unwise to rely entirely upon statistics obtained from stomach dissections and to say that because the figures show large percentage of grain that the rook is doing a great amount of damage to the crops. It has been frequently observed that rooks, when feeding upon grain in September and October, are not doing any damage to the crops but are merely taking the grain which has been dropped during harvesting operations. By reference to Table No. I. it will be seen that the supplies of birds for September and October were, with one exception, all obtained from localities in the Southern and Midland Counties of England where harvesting has generally been completed by the middle of September, hence it by no means follows that because grain was taken in 100 per cent. of the birds examined (Table No. II.) that the rook was doing damage to the extent indicated. Again, the number of specimens received for September and October was very small, from which it is impossible to obtain reliable data. As previously indicated an even number of birds should be received each month from the same and as many localities as possible, and after obtaining careful observational evidence and also taking into consideration the available food and the relative abundance of the rooks we should be better able to judge the true position the rook holds with regard to agriculture.

Summary.

The results of this investigation so far as it has progressed from the consideration of 209 stomachs shows: —

(i) That a large proportion of the food of the rook consists of grain, and that it is taken mainly in the autumn, winter, and early spring months.

(ii) The total amount of animal food is not so large as grain, but reaches a high percentage during May, June, July, August, and September.

(iii) There is *some* evidence to show that a grain diet *may* be preferred, but there is also evidence which shows that a great many insects (about half of which are injurious) are taken by the rook particularly in its nestling stage, and that it is therefore most important to have a good supply of birds during this phase in its life-history.

(iv) It is difficult from the evidence yet obtained by this inquiry to say whether the rook is on the whole a beneficial or an injurious bird, as the material upon which the account is based is not sufficiently representative.

(v) The only satisfactory way to obtain a correct idea of the economic status of the rook is to have an even supply of birds each month from the same and as many localities as possible so that they can be examined when feeding under all kinds of conditions; it is most important to have reliable observational evidence, and careful consideration must be given to the available food supply and the many facts connected with migration. It may in some cases be impossible to arrive at a perfectly definite conclusion as to the bird's economic status, as the conditions under which the rook lives are so complex and vary from time to time, but even if this were the case there would be a distinct advantage in knowing that the problem had been subjected to a properly organised scientific inquiry and was free from the prejudice which so often characterises the thoughts of persons interested only in one particular subject.

TABLE I.

Months.

County.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Aberdeen ...	1	—	1	1	1	1	2	—	—	—	—	—	7
Cheshire ...	—	1	—	—	5	—	—	—	—	—	—	1	7
Cumberland ...	4	1	4	4	—	—	—	2	—	—	—	1	16
Denbighshire ...	6	6	11	5	7	6	—	6	—	1	—	2	50
Derbyshire ...	—	—	—	—	—	—	—	—	—	1	1	—	2
Devonshire ...	7	5	11	—	—	—	3	2	—	4	—	1	33
Dublin County...	2	—	—	—	—	—	—	—	—	—	—	—	2
Edinburgh ...	5	—	—	2	1	—	—	—	1	—	—	1	10
Essex	1	—	—	—	—	—	—	—	—	—	—	—	1
Fifeshire ...	2	1	3	1	1	—	—	—	—	—	4	—	12
Gloucestershire...	1	—	3	1	2	2	—	2	2	1	1	1	16
Hampshire ...	1	—	—	—	—	—	—	—	—	—	—	—	1
Hertfordshire ...	1	—	1	—	2	—	—	—	—	—	—	1	5
Huntingdonshire	—	—	1	—	—	—	—	—	—	1	—	—	2
Montgomeryshire	—	—	1	—	—	—	—	—	—	—	—	2	3
Oxfordshire ...	—	—	—	1	1	—	—	—	—	—	—	1	3
Pembrokeshire...	1	1	1	1	5	—	—	—	—	—	—	2	11
Shropshire ...	—	—	—	—	1	—	—	—	1	—	2	—	4
Somersetshire ...	1	—	2	—	1	—	1	—	—	—	—	—	5
Warwickshire ...	—	—	—	—	5	—	—	—	—	—	—	—	5
Wight, Isle of ...	—	—	—	—	—	—	1	1	—	—	—	—	2
Yorkshire ...	5	—	—	—	—	6	—	—	—	—	—	—	11
Total ...	38	15	39	16	32	15	7	13	4	8	8	13	208

TABLE II.

Tabular statement showing the percentage number of times a certain food item is taken.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Number of gizzards examined.	38	16	39	16	32	15	7	13	4	8	8	13
Injurious Insects...	7·8	6·2	12·8	31·2	65·6	73·3	85·7	46·1	50	37·5	—	23·0
Useful Insects ...	2·6	—	15·3	31·2	25·0	22·6	57·1	61·5	75	12·5	—	23·0
Doubtful Insects...	15·7	6·2	17·9	31·2	46·8	66·6	71·4	61·5	50	50.0	12·5	38·4
Other Injurious Invertebrates.	2·6	—	—	—	12·5	—	14·2	15·3	—	—	—	15·3
Other Useful Invertebrates.	—	—	—	6·2	9 3	—	—	—	—	—	—	7·6
Other Doubtful Invertebrates.	10·5	12·5	28·2	49·6	31·2	13·3	42·8	53·8	—	12·5	—	15·3
Grain	57·8	87·5	82·0	93·6	84·3	26·6	28·5	76 9	100	100 0	62·5	84·6
Weeds, Seeds, and Roots.	10 5	—	2·5	6·2	9·3	6·6	—	—	—	—	—	—
Roots	15·7	—	23·0	12·4	43·7	33·3	71·4	38·4	—	—	—	7·6
Miscellaneous Animal Matter.	21·0	12·5	12·8	—	6·2	13·3	28·5	7·6	—	—	—	30·7
Miscellaneous Vegetable Matter.	55·2	43·7	38·4	37·2	43·7	73·3	28·5	53·8	—	87·5	62·5	53·8
Grit, Earth, &c. ...	21·0	25·0	28·2	31·2	31·2	46·6	85·7	61·5	100	100·0	37·5	30·7

Table III.

This table shows the percentage number of times certain food items have been taken during the whole time covered by this inquiry, *i.e.*, from November 30th, 1908, to December 7th, 1910.

Injurious Insects	Leather-jackets, 15·3 Wireworms, 9·09	36·6
Useful Insects		27·4
Doubtful Insects		35·8
Other Injurious Invertebrates		4·9
Other Useful Invertebrates		1·9
Other Doubtful Invertebrates		22·3
Grain		73·6
Weed, Seeds, and Roots		2·9
Roots (Potatoes, &c.)		20·4
Miscellaneous Animal Matter		11·0
Miscellaneous Vegetable Matter		48·1

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